TITLE OF THE INVENTION

Emulated IP-Call & Services System Method & Apparatus

The present invention claims priority to US Provisional Application 60/546,421 filed February 20, 2004.

BACKGROUND OF THE INVENTION

Field Of The Invention.

The present invention introduces IP-end points in a TDM-switch. More particularly, the invention provides a solution whereby an IP subscriber connection can be established relating to a TDM-switched connection. In realizing this solution, the invention further offloads the TDM traffic over IP network without a routing data base, extends the redundancy concept in the sense that the IP network is backed by TDM and provides wide range of TDM features to these IP-endpoints.

Related Information.

The TDM network has evolved and enriched itself by innumerable features in the last decades. Meanwhile, the IP network is growing with astonishing speed. Each of these networks has its merits. TDM is very reliable and feature-rich with quality of service, while IP offers multimedia, more flexibility and point of presence (POP) for its end points. There is a growing desire, both in the business sector as well as in the consumer segment for an IP application. However, this goal cannot be fulfilled without interoperability of the two networks. The marriage of the two networks is catalyzed by the fact that the major number of subscribers exists in the TDM. Any IP-subscriber calling a TDM subscriber has to go inevitably through a gateway (GW).

It should be remembered that TDM networks are a mature network technology consisting of highly invested and very costly evolved elements that cannot be simply put aside.

There have been various efforts in telecom industry to address this issue. Many solutions have emerged, but most solutions sacrifice one-or-more aspects of one to get the other in contrast that combines the virtues of both parties. At the same time, however, the IP network has not gone through a similar evolution in functionality. IP, therefore, should fill the gap by utilizing the TDM network.

It has been proposed to connect IP subscribers through a TDM connection. However, this solution is unsatisfactory. For one thing, the number of channels utilized by the IP connection over the TDM line would compete with the TDM connection. In addition, IP tends to require much more bandwidth than TDM and the amount of channels required is sure to stretch the limits of the typical TDM network. On the other hand, and as mentioned before, IP is not as refined as TDM and does not offer the same feature rich set of call services as TDM.

In other words, the heart of problem is how one can provide an IP-end point (along with its virtues) but utilize TDM switch functionality, particularly TDM's routing and feature fabric. Further, an object of the invention is to provide services for such an IP / TDM network. For a subscriber of an IP-Connection (IP-CON), TDM features are still available. However some features in TDM require the knowledge of existence of the active (ongoing) call, which may have been moved from TDM into IP by an IP-CON of the present invention. In order to provide a complete solution, therefore, the invention aims to maintain and extend these services. This leverages complexity of feature handling.

Take, for example, the situation where a regular call attempt to a busy pure-TDM-subscriber in TDM, leads to call waiting subscription verification and eventually Call Waiting (CW) handling. The same call attempt to an IP-CON subscriber, which may have an IP-call active, would not give the same result. From the point of view of the TDM switch, this subscriber is idle. Therefore, the new incoming call will not lead to a call waiting subscription verification. The switch shall simply attempt to present the call to the subscriber that is believed to be idle. This is true for all B-side features. What is needed, therefore, is an IP-CON solution that incorporates the TDM functionality.

SUMMARY OF THE INVENTION

An object of the present invention is to maintain the TDM switch.

An object of the present invention is to not impact the TDM switch.

An object of the present invention is not introduce a new node.

An object of the present invention is to offer IP-endpoints on the TDM switch.

An object of the present invention is to utilize TDM routing function.

An object of the present invention is to utilize TDM administration. An object of the present invention is to use minimal TDM resources for introduced IP-endpoints.

An object of the present invention is to utilize the feature fabric capability of the TDM switch for introduced IP-endpoints.

An object of the present invention is to provide scalability.

An object of the present invention is to provide a generic solution independent from the TDM-switch.

An object of the present invention is enable the usage of TDM-feature fabric in the new IP-CON environment with limited exceptions.

An object of the present invention is to provide TDM call services for an IP subscriber connection.

In accordance with the foregoing objectives, there is provided an IP-subscriber connection in correspondence to an existing TDM connection between a subscriber A on an A-side of the TDM connection and a subscriber B on a B-side of the TDM connection. A set up signal including IP connection information and a caller ID of the subscriber A is sent to the B-side over the existing TDM connection. The A-side is invited to set up an IP connection from the B-side including IP connection information and a caller ID of the subscriber B. Next, the IP-subscriber connection is established based on the IP connection information and caller ID from the subscriber A and the subscriber B.

There is further provided TDM call services and features for this IP-subscriber connection. The IP-concentrator sets a trigger that causes a TDM switch on the A-side to pass control of an incoming call to the IP concentrator on the A-side. The TDM switch is instructed to resume call processing of the incoming call when the trigger is triggered.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates the TDM emulated IP call of the present invention;

Figure 2 illustrates the TDM emulated IP call basic flow of the present invention;

Figure 3 illustrates the IP-CON basic call flow of the present invention; and

Figure 4 illustrates the call flow for a call waiting according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention introduces an IP-CON element to the TDM network. From the viewpoint of TDM-switch, IPCON, as a physical entity, acts as a subscriber concentrator (IP-Concentrator). But from the viewpoint of IP-network, IPCON is a call agent for the IP-subscribers.

The present invention shall now be discussed with reference to Figure 1, wherein a proposed network configuration 100 for the TDM emulated IP-call is shown. Figure 1 assumes that the calling and the called termination are both IP-end points. At first glance, the figure resembles the common IP to TDM-TDM to IP call, seizing both IP and TDM resources for a single call. However, the figure includes some important differences. As will be made clear in the description below, the solution presented here adopts the philosophy that the TDM path is excessive and obsolete. In Figure 1, The A-IPCON 102 receives the call request 104 from an A IP- subscriber 106, and forwards a corresponding setup 108 to the TDM-switch 110 (via, for example GR303 / V5).

The subscriber 106 is authenticated by the A-IPCON 102 to determine the subscriber's IP nature. The subscriber is further validated by the TDM-Switch 110 for its subscription.

The call is then authenticated by the TDM network 112. The routing functionality of the TDM is utilized to select the facility. The TDM facilities are seized through the TDM network to the terminating office 114. The terminating office 114 is invoked to present the call to B-IPCON 116. A bearer-channel 118 is seized and TDM path between the involved A and B-IPCONs 102, 116 is setup. The A-IPCON and B-IPCON 102, 116 use the provided TDM path to exchange signals with each other. There are three methods to realize this signaling (explained later).

Having collected the necessary information (IP address and etc) the involved IPCONs 102, 116 attempt to setup an IP-connection 118. Once the IP-connection between A and B-IPCON 102, 116 is setup, the IPCONs 102, 116 negotiate the bearer path 118 through the IP-network 120. After the bearer path is established, the IPCONs 102, 116 can drop the TDM call so that the combinational path IP-TDM-TDM-IP from now on can be collapsed into one single IP path.

As previously indicated, the A-IPCON and B-IPCON 102, 116 of the previously described solution use the provided TDM path to exchange signals with each other. The instant solution provides the IP-CONs 102, 116 with at least three methods to realize this signaling.

In a first method, there is provided an ISDN configuration. In this case, an A-IPCON 102 sends UU-info at the time of setup request, which is forwarded through to the B-IPCON 116. The B-IPCON 116 detects the IP nature of the originator. The B-IPCON 116 can initiate an IP-connection back toward the A-IPCON 102 using the information collected from the UU-info.

In a second method, there is provided either an ISDN or Analog configuration. The TDM-call presentation to the B-IPCON 116 includes the necessary information about the A-IPCON 102 using calling name delivery. Thus, the B-IPCON 116

detects the IP-nature of the origination. The B-IPCON 116 can initiate a backward IP-connection to the A-IPCON 102.

In a third method, there is provided an ISDN or Analog configuration. After the TDM-call is answered, the bearer path 118 is bi-directionally established. Hence, both IPCONs 102. 116 can exchange information inband. Any one of the IPCONs 102, 116 can be chosen to initiate the IP-connection.

The three methods may be utilized individually or in any combination. A combination of the above three methods may guaranty interoperability between different implementations of IPCON.

It shall be appreciated, that dropping the TDM path and collapsing the paths (IP-TDM-TDM-IP) into one path (purely IP), can be performed in a dynamic scalable manner. The flexibility of the method described above is best understood by the following facts. After the two paths, IP and TDM, are established, the IPCONs can decide to drop any one of them or re-establish any one of them at any given time during the call. This can be used as a unique feature to empower a connection to become fault tolerant. The capability to decide provided by this solution to realize a connection on any one of the two networks (TDM or IP) offers a great deal of flexibility to dynamically control the load distribution. This solution is, in particular, beneficial for network congestion control.

Thus, the suggested basic call for an IP-endpoint calling another IP-endpoint with seizing the TDM resources only for the purpose of utilizing the TDM routing and signaling. Obviously, if one of the involved parties is purely TDM, then the TDM connection should not be dropped. Moreover, it shall be appreciated that if the information in the a-to c- could not be interpreted by the involved A and B-side call agents,

then the connection should remain as a TDM, regardless of the nature of the subscribers.

This solution hosts other advantages. From the viewpoint of TDM switch, the IPCON is a GR303/V5 concentrator, and all IP-subscribers behind the IPCON appear as regular subscriber to the TDM switch. Therefore, the administration of these IP-subscribers can be incorporated into the TDM-switch without any impact. Since the IPCON initiates every call through the TDM switch, therefore the TDM-feature fabric can be fully utilized.

Now with respect to Figure 2, the basic flow 200 of the TDM emulated IP-call will be described. In this illustration, the IPCONs act as the call agents. First, the TDM pathway is set up. For this, an IP call request 201 is sent from the subscriber A to the call agent. Then a TDM SETUP signal 202, which may include the UU-INFO= A-IPCON ID, CALL ID, is sent from the call agent to the switch. An SS7 IAM signal 203 is then sent to the signaling transfer protocol device from the switch. Next, a TDM BEARER_PATH SETUP signal 204 is sent from the switch on the subscriber A side to the switch on the subscriber B side. A TDM SETUP(UU-INFO= A-IPCON ID, CALL ID) 205 is then sent from the subscriber B side switch to the call agent on the B side.

Now, the IP call flow is set up. First, an IP REINVITE signal 206 (that may include such information as the CALL ID, B-IPCON ID, etc.) is transmitted from the call agent on the B side to the call agent on the A side. An IP HANDSHAKE 207 is returned from the A side call agent and the B side call agent sends an IP call request to the B subscriber.

At this point, the IP BEARER PATH SETUP 209 is set up. The B subscriber transmits an IP CONNECT signal 210 to the call agent on the B side. The B side call agent sends an IP CONNECT signal 211 to the A side call agent. And the IP call

connection is completed when the A side call agent sends an IP CONNECT signal 212 to the subscriber A.

The TDM connection may be abandoned at this point and pure IP path communications allowed to proceed alone. In this case, the B side call agent sends a TDM RELEASE signal 213 to the B side switch. The B side switch sends an SS7 RELEASE signal 214 to the A side switch. Finally, the A side switch sends a TDM RELEASE signal 215 to the A side call agent.

The signaling of the IP-CONs will now be described with reference to the call flow 300 shown in Figure 3. In the figure, a first subscriber IP-sub1 302 sets up a call flow to a second subscriber IP-sub2 312. A first IP connection IP-CON1 304 signals a switch 1 306 to connect through to a second switch 2 308 that signals a second IP connection IP-CON2 310.Now, in the basic call flow, these elements establish an active IP call 312. A user-initiated call 314 invokes an offhook setup invite 316 from the IP subscriber 1 302 to the IP-Con1 304. Dependent on the subscriber type, ringback may be provided. A setup signal 318 is then provided from IP-CON1 to the Switch 1 306. At this time, a TDM callsetup 320 is sent from the switch 1 306 to the switch 2 308. A setup signal 322 is then sent from the switch 2 308 to the second IP-CON2 310. At this point, the IP-CON2 send an IP-CON2 info signal 324 to the IP-CON1 304. The TDM call up to the "call presented" ringing is established. At this time, the IP-CONs can decide to continue with the TDM or establish a pure IP path and switch the subscribers to IP communications.

Then, the IP-CON2 310 sends a ring setup invite 326 to the IP subscriber 2 312. Again, dependent on the subscriber type, ring may be provided. At this point, the IP subscribers can communicate through the IP connection.

Now that the basic call flow has been described, a method for providing call services and features in this new type of network shall now be described. The following Figure 4 depicts as an example suggested call flow 400 for call waiting. Here again are depicted an IP subscriber 1 402, an IP-CON 1 404, switch 1 406, a switch 2 408, an IP-CON2 410 and an IP subscriber 2 412. In the first case the IP call is set up. The problem now is that the subscribers are either connected to the IP-subscriber connection, and therefore not available, or disconnected from the TDM connection altogether. In other words, there is no call handling between the subscribers. To explain the problem in more detail, if you are going to use the feature fabric of the TDM, then you run into some problem. Assuming you want to do call waiting, for example, if a calls b and there is a TDM connection and shake hands over IP and drop IP, both a and b switches think the subscribers are in an idle state.

In either case, the present invention re-establishes connection to the subscriber A TDM environment in order to allow an incoming TDM call service or call feature to be applied to the subscriber A. It must be remembered, however, that the solution is not so simple. If someone attempts to call subscriber A, the TDM switch will determine that the party A is idle and will try to deliver the call. Although subscriber A has the subscription, he will not receive anything. In fact, this will cause spurious error which are too ambiguous to comment on here. On the switch side, the call waiting tone is forwarded.

The problem is how can TDM features be provided to such subscribers who are re-connected via the TDM connection but who are unavailable because they are actually in communication with an established IP connection. The solution provided here is to recognize that the set up can be toggled between the 2 calls (TDM / IP). But in order to do

this, the invention must provide some special mechanisms in order to arrange for TDM call services and features.

In summary, the idea is to trigger TDM switching as soon as the call comes in for the A side party. For example, the present invention sets up a trigger, which may be an advanced intelligent network (AIN) trigger, that is triggered as soon as a TDM call comes in. The idea is that that the call is not handled in the TDM switch, but rather by the IP-side since the IP is handling the current call connection. The first thing the TDM switch does is send a query to a SCP (signalling control point). In the exemplary case, we define the concentrator to be the SCP for this case. This causes the TDM switch to forward the query to the IP controller, here the IP-concentrator. In this example, the IP-concentrator is the only element that knows the true status of the parties and, thus, is the device capable of handling the incoming call.

In the case that the A subscriber is not active, the IP-concentrator sends a signal to the TDM switch that indicates to the TDM switch that the call may be established. In response, the TDM switch proceeds to connect the incoming call to the A subscriber. However, in the case that the A subscriber is active, such as in the present case where an IP connection is established, the IP-concentrator creates the TDM call and sends to the TDM switch that should go ahead with services.

As previously mentioned, one manner in which to resolve the above problem is to use IN-triggers for IP-CON subscribers. This is in part due to the lack of knowledge of the TDM switch, as previously mentioned. In one particular aspect, for all IP-CON subscribers, the B-side trigger Termination_Attempt are armed. In laymen's terms, this means that whenever a remote caller wants to terminate to this

subscriber, i.e., connect, then the IP-concentrator is sent a set_up message. The Global translation resolves to point to the IP-concentrator. Thus, for an incoming call the trigger is triggered, and the TDM switch sends an IN-query to the IP-CON. A TCAP dialog between the switch and the IP-CON, informs the IP-CON of an incoming call for an IP-CON subscriber. The TDM-switch is not aware of the real status of the IP-CON subscriber, but the IP-CON is aware of ongoing transactions and, thus, is capable of making the connection.

In terms of a method, the IP-CON initially determines whether its subscriber is involved in an IP-call. In this case, the IP-CON verifies which IP-CON (own or partner) originated the call. Next, the IP-CON informs the partner IP-CON of the need to reestablish the ongoing IP-call over TDM. As a next step the originator IP-CON reestablishes the TDM call. Finally, the IP-CON instructs the TDM switch is via TCAP message (CONTINUE ) instructed to resume the incoming call processing. On the other hand, when the IP-CON determines its subscriber is idle then the IP-CON sends a CONTINUE signal to the TDM switch to instruct the TDM switch to resume the incoming call processing.

It shall be appreciated that the IP-concentrator plays two roles. As concentrator of IP, the IP concentrator collects and bundles IP packets and decides when enough are accumulated in the buffer to be sent. Second, but also as scp).

Now that the central idea has been described, a practical application for arranging a call service, in this example call waiting, will be described with reference to Figure 4. Of course, any other type of call service may be implemented using the following technique. Initially, a new incoming call signal 414 for the subscriber 1 is initiated and sent to the switch 1 406. Then, a termination attempt 416 is sent from the switch 1 406 to the IP-CON1 404. Since the originator of

the call should re-establish the TDM call, the IP-CON1 404 sends a setup signal 418 to the switch 1 406 and the switch 1 406 sends a TDM set up call signal 420 to the second switch 408. The switch 2 408 signals a termination attempt 422 to the IP CON 2 410 and the IP CON 2 410 signals its response to continue 424. In return, the switch 2 408 sends a setup signal 426 to the IP CON2 410. The basic call flow for TDM is continued until the TDM path is re-established.

Now that the TDM connection is re-established, the next step is to provide for the call feature. At this time, the IP CON 1 signals a response continue signal 428 to the switch 1 406 and the switch 1 406 verifies the call waiting subscription. Now, the switch 1 406 signals 430 the IP CON1 404 to set up a call waiting tone. The IP CON1 404 issues a signal 432 that causes the IP subscriber 1 to sound the call waiting tone. The first subscriber receives the call waiting tone and puts the first call on hold in order to receive the new call.

Another way of resolving the problem is to use a pre-existing Call Forwarding feature that is, for example, provided by the TDM network. This may be applied according to the call flow processing already described above. Whenever an IP-CON establishes an IP call for one of its subscribers, that IP-CON activates Call Forwarding feature for that particular subscriber so that any incoming call for that subscriber gets forwarded to the IP-CON. In this way, the IP-CON can decide how to proceed with delivery of the new incoming call. In this method, the IP-CON should have knowledge of the subscriber service-subscription. Since the details of call forwarding are already known, the description here shall not elaborate on the inner workings of this know call feature service.

It shall be appreciated that, although the invention has been described in accordance with a particular embodiment, the invention may be practiced or modified in another manner than

that described without deviating from the nature and scope of the invention. In addition, The method shown in the call flow above proves to be applicable to a broad range of TDM-features. These include not only the Call-Waiting already described, but the whole host of TDM features provided by the TDM network.